DATA PROCESSING DIGEST

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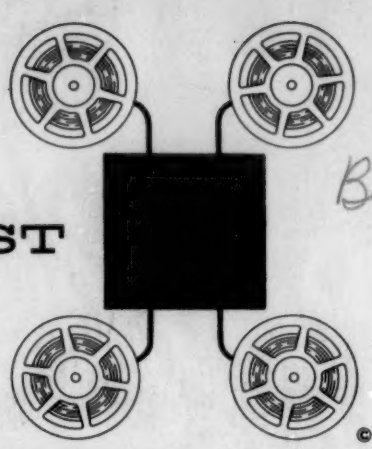

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Systems Design

LOGIC-STRUCTURE TABLES

H. N. Cantrell, J. King and F. E. H. King, General Electric Co., Schenectady, N.Y.
COMMUNICATIONS OF A.C.M., June 1961; pages 272-275

Since logic tables have been compiled into computer programs, some conventions and common language must be devised for easy use. A complete table is a compact expression of many "paths in parallel" so that the viewer may see what the paths have in common and where they lead. The title of a logic table plays an important role because one gets to a table by being referred to it by name. The upper left quadrant (A) contains a series of questions while the upper right quadrant (B) has columns of possible combinations of answers. The lower left quadrant (C) contains the quantity or quantities which require evaluation, and the lower right quadrant (D) contains columns of values corresponding to the combinations of answers in B quadrant.

The procedure is to start at the left most column of the B quadrant, see if it contains the combination of answers with which we entered the table. If it does, proceed down the column into the D quadrant and draw conclusions. If the first column does not contain the desired combination of answers, move on to the second column, then the third, and so on, until the first correct column is reached. Having reached the first correct column, ignore any further columns to the right even though some may contain valid combinations, and move down into the D quadrant.

Logic tables form a way of thinking as well as an organized way of expressing those thoughts. By the discipline of the technique, one is forced to include in a table all possible paths, and eliminate ambiguities.

People have difficulty in developing and using logic, mainly due to the inability of the human mind to consider simultaneously more than a few alternatives and their relationships. Logic tables are two-dimensional in nature and hence enable us to express and consider both the sequential and parallel aspects of logic. This makes them uniquely suited to logic development and expression.

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TABLES SIGNAL BETTER COMMUNICATION

Burton Grad, IBM Corporation, Yorktown Heights, New York

This is a paper which explains the value of decision tables in stating complex decision problems. Decision tables are a formal method for describing decision logic in a two-dimensional display. They use a format which is familiar to us from analytical, financial, and statistical tables. They are used to represent dynamic situations. An example of file maintenance is used to demonstrate the way in which tables may be set up. "Tabular form will have to be tried and used on a wide variety of applications to provide practical evaluation and determine desirable characteristics. Along with this field pre-testing, there will be a need for effective technical developments to explore new table concepts and structures."

((Copies of this paper may be obtained from the author, c/o IBM Corp., P. O. Box 218, Yorktown Heights, N. Y.))

TABULAR FORM IN DECISION LOGIC

Burton Grad, IBM Corporation, Yorktown Heights, New York
DATAMATION, July 1961; pages 22-26

A simple explanation of logic tables is given, along with illustrative charts. Some history of the development of this important new analytical tool is given; Mr. Grad was one of the pioneer innovators of the technique. The file maintenance illustrative example is described in more detail in Mr. Grad's other paper digested above.

TO OUR SUBSCRIBERS IN OTHER COUNTRIES:

Over the past several years we have retained for our subscribers abroad, a postage rate of $2.50 per year per subscription. This has covered only about 3/4 of the actual cost of postage to countries outside the United States. Postal rates have been increased considerably during 1961, and we find it impossible to continue this low rate. We deeply regret having to raise the postage for foreign subscriptions to $4.50. This rate will take effect as of this date for all new subscriptions, and on all renewals as they become effective.

General Information

ADMINISTRATION OF ELECTRONIC DATA PROCESSING

Published by National Industrial Conference Board

Ten chapters and an appendix make up this report, and it is full of valuable information for companies who wish to begin thinking about EDP. Somewhat of a "how-to" book on the subject, it begins with the assumption that the company's executives are only dimly aware of the detailed planning necessary for investigating and installing an electronic data processing system. This approach gives the report a real hand-book quality that should be invaluable to the organization which doesn't know where to begin. Nine case studies of well known successful installations are used to illustrate the suggested procedures. Copious use is made of charts and illustrations. The ten chapters include: Gaining Background Knowledge (of company requirements, not of EDP itself); Planning the Feasibility Study; Planning the Systems Studies; Studying Computer Equipment; Recommending a Course of Action; Organizing the Data-processing Activity; Defining Jobs and Selecting Personnel; Evaluating Performance and Progress; Gaining Employee Cooperation; Other Administrative Problems (systems changes, second and third shifts, contract arrangements, service bureaus, etc.).

It may be noticed that some of the chapters cover subjects not generally well-covered elsewhere--for example, defining jobs and selecting personnel, in which some actual examples of job specifications are reproduced. The lack of a good bibliography was somewhat annoying to us, and we were surprised to find, not an index, but a detailed table of contents at the end of the report. Other than these two fairly unimportant criticisms, we feel this is a valuable report. Cost: $25.00. Write to: National Industrial Conference Board, Inc., 460 Park Avenue, New York 22, New York.

DESIGNING TODAY'S AUTOMATION SYSTEM TO MEET TOMORROW'S NEEDS

Neal J. Dean, Booz, Allen and Hamilton
Paper presented to National Conference on Banking, May 1961

Banks are admonished, in the planning of their EDP systems, to consider three major categories of applications: 1) those applications selected for immediate conversion to the computer; 2) all other present applications which are potentially adaptable to computer processing; 3) all probable future applications which are not as yet offered as services by the bank.

The first category above might include demand deposit, installment loan and personal trust, for a total of 8 hours per day of computer usage. The second category could include automatic deposit-proof and transit, corporate trust, community charge plan, savings, bank payroll, revolving credit, and internal accounting, for a total of 7 hours per day of computer time. Future applications, taking a total of 6 hours per day, might include correspondent bank deposit accounting, account reconciliation, and customer accounting Other future applications might include centralized loan accounting, centralized credit inquiry, correspondent clearing and transit services, and mutual fund accounting.

Plan for the future system

Equipment required for the bank should be capable of meeting the bank's primary needs in a single shift, and the secondary and future applications within another shift and a half for the anticipated ten year life of the equipment.

Expansions of equipment to accommodate additional applications, however, may create undesirable programing and system changes and can completely change the original economics on which the system was selected. Thus, the expandability feature of the new equipment should not be the basis for adding new applications, unless the original system planning provides for economical addition of computer equipment in a systematic manner.

The computer may be used for internal management services such as asset management, market research, internal cost accounting, security analysis, account profitability analysis, account information updating, credit inquiry, and management training. Any of these management activities may be performed with present computers and management techniques.

Future implications of computer usage may result from new withholding tax laws on interest and dividends. Also, banks may be required to report the detail of checking account profitability for tax purposes. A more remote possibility is the reporting of all banking information by social security number direct to the Internal Revenue in a format prescribed by the IRS system.

A copy of the paper may be obtained from the author at Booz, Allen & Hamilton, 135 S. La Salle St., Chicago 3, Ill.

CHECK DIGITS

Oliver E. Gralen, Continental Illinois National Bank and Trust Co.
AUDITGRAM, July 1961; pages 16-18

A self checking digit is used to verify the accuracy of an account number. A method that is becoming widely accepted is based on modulus 11 with an arithmetic progression of weights for each of the digit columns (units digit is weighted "1," ten digits "2," hundreds

digit "3," etc.). This formula is effective for all types of errors except those of a compensating nature that include certain combinations of double transpositions. In an attempt to overcome this deficiency, a refinement was proposed in which a geometric progression of the column values was substituted for the arithmetic progression. However, this system also reveals that certain numbers which may be easily transposed develop identical check digits. The problem can be solved by mathematical analysis, as shown in a chart included in the article. The chart reveals that of 8100 possible double transpositions there are 810 which will not be detected by the arithmetic system and 810 which will not be detected by the geometric system. It appears, therefore, that the arithmetic and the geometric systems are equally effective and that no formula developed so far provides complete protection against all the possibilities that exist in recording account numbers. Fortunately, double transpositions are fairly infrequent. "The selection of a particular check digit formula is a problem that does not always lend itself to unequivocal evaluation. Systems concepts and operating requirements differ to such an extent that no specific conclusion will apply equally well for all situations."

LEGAL ASPECTS OF MICR PROGRAM

DATA PROCESSING (U.S.), July 1961; page 36

Bankers who attended the Conference on Banking Automation, sponsored by the Detroit Research Institute last May, discussed the legal responsibilities connected with errors in MICR check processing. These problems could arise not only from misprinted, lost, or stolen coded checks, but from incorrect encoding of amount and from the complex routing of checks from the originator back to the payor bank.

AUTOMATION ANSWERS

AUDITGRAM, July 1961; pages 42, 43

The Central Bank & Trust Company of Denver decided to do its own check imprinting with an A. B. Dick offset press which prints personal checks four-up. Their decision was based on these reasons:

1. They had been doing personalized check imprinting at the bank for more than 10 years, and their customers liked the free service.

2. They wished to exercise complete control over account numbers.

3. By controlling every step of the MICR system, they discovered ways to handle more business at no increase in costs.

A new account is assigned a number from a batch of pre-numbered IBM cards given the account officer. He prints the new customer's name and address on the card, and circles other appropriate information. This card becomes, among other things, the check order form. Along with a signature card, the IBM card is sent by pneumatic tube to the check imprinting room where it is turned over to a Flexowriter typist. She prepares a paper master (four accounts will fit on one master), at the same time creating automatically an edge-punched card which is filed and used for re-orders. While the typist is preparing the master, the account number is automatically typed from the IBM card.

The offset press may be reset in about four seconds to accommodate business checks, which are larger, and are printed three-up. Most orders are mailed out the same day. The edge-punched cards used for reorders are inserted into a Friden "reader" unit to prepare automatically the offset master.

AUTOMATION AT FIRST AND CITIZENS ENTERS THE HOME STRETCH

George W. Mossburg, First and Citizens National Bank, Alexandria, Va.
AUDITGRAM, July 1961; pages 10-14

The Cashier of the First and Citizens National Bank of Alexandria gives a step-by-step description of the conversion from manual to MICR system, using NCR Postronic machines and Pitney-Bowes National sorter-reader. Recently, the bank acquired an NCR 310 computer.

AUDITING IN THE AGE OF EDP

Virgil F. Blank, Haskins & Sells, San Francisco, California
JOURNAL OF MACHINE ACCOUNTING, July 1961; pages 34-41, 71

The internal auditor can use the EDP system, not only to do the conventional type of auditing and control, but also to use the potentialities of the equipment in new ways. Some examples are suggested.

1. The internal auditor could design a model of what he does when he audits the accounts; then design an EDP program for doing this same work.

2. In auditing by exception, he can state in quantitative form what the standards are for a given situation. Then he can obtain automatically from the computer only those items which require his attention.

3. Many detailed registers of transactions (audit trail documents) may be eliminated, through proper timing of review procedures.

4. The internal auditor's time is flexible enough that he could assume the duties of many of the special purpose auditors; for example, wage and hour examiners, income tax and sales tax auditors.

5. Control can be transferred to the data origination point, rather than kept in the accounting office. This will enable the internal auditor to prevent errors rather than merely catch them after they have been committed.

6. New management science techniques mean that historical comparison of current results with prior years' results are traded for comparison of actual operating results with those that were planned. As a result, favorable and unfavorable situations are revealed, many of which are meaningful to the auditor.

7. Quality control may be introduced into the office. This means that certain costly controls would be eliminated where it is found that the expense of maintaining the control exceeds the cost of the error.

EFFECTS OF EDP ON INTERNAL CONTROL

Felix Kaufman, Lybrand, Ross Bros. & Montgomery, New York
JOURNAL OF ACCOUNTANCY, June 1961; pages 47-59

This article appears as a chapter in the author's book, "Electronic Data Processing and Auditing" ((See DPD: June 1961; page 6)). Internal controls need to be self-controlling and based upon consistency of information. Some conclusions about proof totals are given:

1. Computer systems emphasize the proof total control for checking the movement of batches. The accuracy of a computer de-emphasizes the proof total as a posting check.

2. Developments in random access equipment and in on-line transaction recording eliminate the need for batching as a preliminary to processing data. Batching, therefore, becomes a special requirement imposed by proof total procedures.

3. The automation of connections between recording and processing is likely to cause the elimination of batch methods as tests of transmission accuracy.

4. At present, the consolidating tendencies in electronic data processing promote separate computer runs to implement some control features, including proof total tests on transaction batches.

Computers can find errors in systems and data input

"Automatic review" may occur during routine inspection. People performing these jobs are comparing certain data items with tables, or they judge these items with established standards whose values they have memorized. People also inspect data for compatibility reasonableness of magnitudes. A computer can do all of these things automatically.

Since computers are highly accurate in ferreting out data inconsistencies, frequently they are blamed for kicking out errors, when in fact, it is related systems or data input that should be blamed. For example, in retail sales, accurate inventory records depend upon sales clerk discipline when merchandise exchanges occur. If the exchanged merchandise has no price difference, clerks often do not record the exchange. But this has the effect of making two inventory errors, which will be found out by a computer system. Naturally, such an automatic control feature is not automatic in reality, but must be programed. The insertion of controls in a computer system, however, assures that they will operate, barring malfunction of the equipment. The computer becomes a center of control and helps to police noncomputer operations. In effect, the automatic system checks itself and checks operations which preceded its own.

IS MANAGEMENT READY FOR ADP?

Paul J. Hyman, Defense Directorate
ARMED FORCES MANAGEMENT, July 1961; pages 34, 35

Organizations which have large automatic data processing systems find they must have continuous system maintenance based on the feedback of information on system performance and the weeding-out of procedural inconsistencies. Most organizations are developing a group of specialists in information systems analysis. There should be good communications between programers and managers on the use of the computer-printed reports. Otherwise the output may prove to be unusable because of poor planning or change in requirements.

Time for remedial programing should not be underestimated in planning for the ADP system. In one Air Force system, a formal procedure of Deficiency Reporting has been established to report program errors and suggested improvements in operating procedures. Procedures must be standardized over the various locations serviced by the ADP system.

AUTOMATED TEACHING

E. F. Cooley, The Prudential Insurance Co. of America, Newark, N.J.
COMPUTERS AND AUTOMATION, July 1961; pages 10-12

For some subjects, the automated teaching methods are similar to the situation of having a private tutor. This is especially true where the students are well motivated. Teaching machines must have 1) a carefully developed sequence of questions or statements called the "program"; and 2) a way of telling the student immediately whether his answer is right or wrong.

The "scrambled book" method (example: TutorTexts and the teaching machine developed by Norman Crowder of Western Design); and the "Skinner approach" based on the "constructing" of an answer by the student, are the two methods presently used. A third method, which combines these two approaches, has been developed by Dr. Robert Roop of The General Atronics Corporation. In the TAG (Teaching and Grading) systems, "the program is printed in book form and the student records his choice of answers by perforating the answer sheet with ball point pen stylus. The answer sheet is clamped in position over a template for right answers. As the student pushes the stylus through the sheet, he knows at once if his answer is right or wrong by whether the stylus is stopped or penetrates deeply. The type of hole in the answer sheet is a permanent record of his choices."

((DPD, July 1961; page 9: "Teaching Machines and Programmed Learning"))

CAN WE GET MORE FOR LESS?

Sergei Dobrovolsky
CHALLENGE, July 1961; pages 30-33

As important to economic progress as the production of more goods is the amount of capital which must be provided to obtain each unit of output. It is suggested that the results of automation, in addition to being labor-saving, are also capital-saving. This may be achieved through reduction in floor space requirements, lighting, and heating. Also, total investment may be reduced as more operations are simplified and compressed into smaller special-purpose machines. Increased speed of operations may also bring about economies. Through the use of new techniques such as operations research, more precise information may make possible efficient operations which result in a more economic use of working capital.

SHOULD CITY MANAGEMENT CONSIDER ELECTRONIC DATA PROCESSING?

A. W. Hatch, Ebasco Services, Inc., New York City
THE AMERICAN CITY, July 1961; pages 161-165

"The prospects for automation of municipal administrative functions have changed from a costly pioneering venture available only to larger organizations to a practical reality open to a medium or smaller sized city as well.... Managements of medium and smaller municipal organizations are thus faced with the question: 'Should we seriously consider electronic data processing today?' In many cases the answer is definitely 'yes'."

A review of data processing functions should include the data processing requirements and systems designed to meet them, in each of the municipal departments. This type of review should be done periodically, regardless of the present system. Centralization and integration of functions should be considered first. When an efficient information flow has been designed, alternative methods must be considered. A municipal-operations survey can be carried out by competent systems staff at relatively little expense and without disrupting the existing organization. The city government can benefit greatly from such a study, since it is likely to develop opportunities for improvement and cost reduction through consolidation and integration of operations, better utilization of personnel and machines, and more efficient procedures.

WHERE PERT IS HEADED...

ARMED FORCES MANAGEMENT, July 1961; pages 16-18

The PERT system, although considered by some as just another management gimmick, is the only system that provides managers with instant information on the achievement of current objectives, and allows the manager to see what effect one event of the program will have on another event.

The two outstanding features of PERT are its interdisplay of interrelated events, and the critical series of events toward the objective. It shows the manager on paper where events are falling down, and allows him to spot check project progress at will.

PERT must be run by people who know what they are going, and conversely, using the PERT system shows up those areas in the implementation of decisions where management is falling down. PERT requires the most of team effort, at all levels, from top to bottom. The program will fold if one person in the system fails to carry out his responsibility, whether he be top manager or an engineer in charge of a small component. R & D, cost, and reliability are new areas of application for PERT.

Management Sciences

DON'T BET ON BUSINESS GAMES

BUSINESS AUTOMATION, July 1961; pages 22-25, 66

Among some people, business games have become a fad, rather than a tool which can illustrate computer abilities or an introduction to simulation. Used cautiously, management games can help lower levels of management to sense the interdependence of management functions. Also, games can demonstrate the potentialities of the computer in management sciences. However, many facets of the management function have not yet been introduced into games; particularly, the areas of personnel, psychological and organizational problems have not been considered. Nor are the problems of information-gathering adequately handled, with the result that participants often fail to realize how difficult it is to obtain this information in the business world.

It has been suggested by some authorities in games development that future games should include "non-structured" elements such as labor costs and productivity, union problems, effects of public relations and advertising, patterns of business cycles, realistic decision intervals, sensitive environment, human relations problems and research and development.

Information Retrieval

DATA PROCESSING FOR THE LAWYER

Roy N. Freed, Esq.
DATA PROCESSING (U.S.), July 1961; pages 11-24

The primary handicap in using automatic methods for the searching of case reports is the inability of the legal profession thus far "to establish a universally applicable series of definitions of legal terms, concepts and topic classifications; to find in each decision all of the essential facts, and to agree upon a single, authoritative interpretation of each decision."

In trial evidence, the use of machine data processing is feasible at the present time in major antitrust, patent, tax, minority stockholder, rate, license, and similar litigation. This is because the volume of information involved is frequently large enough to justify the expense, and any system devised would be used by a rela-

tively small group of persons who could agree on definitions. The primary value of data processing systems in the above areas is their ability to handle large quantities of indexed information. These large cases involve huge quantities of evidence, both documentary and testimonial. The sheer bulk of such evidence provides the opportunity for slip-ups in human searching systems. Also, it is rare that during such long cases, some of the lawyers, who have so much of the information in their minds only, do not leave the trial staff. Frequently, the evidence is so complex that a new member of the staff has trouble in becoming familiar with the case in time to be of any real value.

Information retrieval for long cases

The use of automatic methods of indexing and searching does not preclude the use of the human mind, since the selection from the index of the topics to be examined is still a function of the lawyers. However, once established, the automatic system can be used by the law office not only on a number of cases simultaneously, but also for office accounting and statistical analysis.

Two sets of facts on punch cards

A punched card system is described in which two separate bodies of facts are maintained during a law suit: the potential evidence and the trial record. As the trial proceeds, the first set of cards is gradually superseded by the second, as the underlying evidence-to-be either becomes part of the record or is discarded. "After the trial strategy has been devised, in order to decide what information to record on the cards and in what form, it is necessary to determine the various fact categories in terms of which the evidence might be analyzed or organized to carry out that strategy as the litigation progresses. This list becomes the index to the evidence for sorting purposes. Since only a limited amount of information may be placed on cards, some kind of a coding system must be devised, a compromise, probably, between the space available and the readability of the coded information. While a single basic card is preferable, the amount of information, particularly relating to persons, may require auxiliary cards. The analysis coding sheet, which provides the keypuncher with the information for the index cards, may be used as a permanent guide to the underlying item of evidence.

Applications

PURCHASING AND AUTOMATION

William C. Herciga, IBM Corporation
PURCHASING, July 13, 1961; pages 66, 67

Computer handles complete order processing

The experience of IBM in using a computer for procurement automation is that exceptions constitute only from 5 to 10% of the total volume of activity. The IBM system "combines the information from the punched card requisition with data from the part-history and vendor tape and assigns a purchase order number. An analysis is performed by the computer to weigh quantity discounts against inventory carrying costs. Output from the system is a completed requisition which is sent to the buyer for review and approval.... Any changes or additions that the buyer has made will be keypunched and entered in the computer in purchase order number sequence. These changes are matched to the open requisition tape. Output is a completed purchase order and a tape record of the new order."

Requests to alter existing purchase orders "are coded, keypunched, and fed to the computer where they simultaneously update the order status tape and trigger the writing of an alteration purchase order. Invoices enter the computer as punched cards. The computer matches invoices to purchase orders and audits quantity, price, extension, discount, routing, and transportation terms. Audit exceptions are punched out for manual control. The order status tape is updated, payment control cards are punched for approved invoices, and accounting distribution cards are prepared from the original order data on tape.

Invoices are set-up for payment as soon as received. Once every two weeks a tape comparison of quantities received and quantities invoiced is made for audit. Payment control cards...re-enter the system for payment in vendor number sequence...are matched to the vendor file and vendor expenditure totals are updated. Final output from the system consists of remittance reporting and vouchers with supporting control totals to balance the payment."

As goods are received, the receiving master card (produced along with the original purchase order) is keypunched with quantity and date and sent to the computer. Updating of the order is performed, and if there is a balance of the order due, a new receiving card is made and returned to the receiving file. "Twenty-one days before the date of first shipment, the computer issues a letter requesting confirmation of shipping date which is mailed to the vendor." This letter is returned only if a change is made. Manual follow-up is initiated by a notice printed automatically on all orders 10 days behind schedule.

WORDS TELL COMPUTER SHAPES OF PARTS TO CUT

SYSTEMS MANAGEMENT, July 1961; page 28

At the United Aircraft Corp. in East Hartford, Conn., an IBM 7090 has been programed with AUTOPROMPT, a numerical control system which can mill a part from English-like instructions furnished by a programer working from an engineering drawing. For example, the bowl-shaped surface of a part might be described in AUTOPROMPT: "Bowl sphere, inside/center (0, 0, 0) radius (1.75)."

THE RAILROAD THAT TAKES TO THE AIR

BUSINESS AUTOMATION, July 1961; pages 32-35

The microwave communications system of the Denver & Rio Grande Western Railroad is described ((see: DPD, August 1961, page 1)). A completely integrated communications system transmits waybill information between the railroad's terminals and agents. Shippers can get immediate information on the whereabouts of their shipments. Car service accounting is done faster and more accurately.

RIO GRANDE'S DATA REVOLUTION

MODERN RAILROADS, July 1961; pages 59-76

Four articles concerned with various aspects of the Rio Grande Railroad microwave system are included. These duplicate or expand articles on this installation included in this month's and last month's DPD.

THE EFFECTS OF ELECTRONICS

W. Everett Jones, The Equitable Life Assurance Society of the U.S.
BEST'S LIFE NEWS, July 1961; pages 67-70

This insurance company installed two IBM 705's and pulled together a number of inter-related ordinary insurance functions into one insurance administration department. This department has charge of the EDP system for its own work and as a service bureau for other departments. Criteria for use of EDP were probable reductions in costs, and speed and accuracy of service. Methods research personnel were assigned full-time to the projects as they were selected, and had full responsibility for development of the new system. The company recognized the fact that new policies or methods are constantly being developed, and existing programs and systems must be continually revised and modified to adjust to new conditions. While it was possible

under the manual system to install makeshift changes, under an EDP system such makeshift practices cannot exist. Therefore, much more careful and detailed planning must be done in advance of the projected change. The company has found that systems outside the EDP system are taking on the same type of appearance, and that as time goes on the distinctions between automated and manual systems as well as studies for new systems will diminish.

Programing

"OPEN SHOP" PROGRAMMING AT ROCKETDYNE SPEEDS RESEARCH AND PRODUCTION

D. J. Breheim, Rocketdyne, Canoga Park, California
COMPUTERS AND AUTOMATION, July 1961; pages 8, 9

"Open shop" programing of engineering problems at the Rocketdyne Division of North American Aviation allows 400 engineers to write computer programs for their respective groups by using a formula translator by which they can address the computer in fairly familiar language. Direct contact with the computers gives the engineers enough understanding of them to program total problems rather than parts of problems. The goal of the open shop is to encourage engineers to solve the largest number of problems by means of workable computer programs, in order to build the best product most economically in the shortest time possible.

The open shop assures fast results. If a routine problem gets to the computer by late afternoon, its solution is on the engineer's desk the next morning. "Same day service" can be obtained if the engineer gets the problem to the computing center in the morning. Priority problems can obtain several shots at the computer in the same day. All programs devised for the engineers at Rocketdyne have been distributed throughout North American Aviation to eliminate duplication of programing effort.

Equipment

THE HYBRID COMPUTER

AUTOMATIC DATA PROCESSING, July 1961; pages 20-23

A major development in computers appears to be the hybrid computer--an integrated analog and digital system--which makes it possible to conduct more economic analyses of certain classes of engineering and scientific problems, and in some cases, superior analyses than by present methods. These systems will be used for integrated planning and control in such functions as process control, production control, and strategic planning and control.

By 1965 "poly-modular data processing systems" will be available which will involve a complex of processors, organized about a communications center which serves as the priority control for data transmission among the various modules. The communications center will probably have the logic necessary to transmit data to and from the various modules without explicit programing instructions. Some kind of problem-oriented language will be used to permit direct interrogation and use of the analog and digital modules. Undoubtedly digital differential analyzers will also be available.

A NEW SERVICE CUTS CLERICAL AND DATA PROCESSING COSTS

Carl E. Lindquist, Western Electric Co., New York
N.A.A. BULLETIN, July 1961; pages 19-24

The Data-phone service permits the transmission of alphabetic and numeric data in any machine language over regular telephone lines. Several manufacturers have developed data transmitting and receiving machines which are compatible with telephone circuits.

DPD IS PLEASED TO PRESENT...

COMPUTER CHARACTERISTICS QUARTERLY

The green pages attached to this issue of Data Processing Digest contain the up-dated Computer Characteristics Chart compiled by Adams Associates Inc. This chart was first published by DPD in the October 1960 issue. It is available also in a handy pocket folder and in the larger chart form from Adams Associates, Inc., 142 The Great Road, Bedford, Mass. We believe you will find this chart both complete and reliable, and a valuable reference guide to currently available EDP equipment.

MACHINES THAT READ

DUN'S REVIEW AND MODERN INDUSTRY, July 1961; pages 26-28

The input bottleneck appears to be solvable with the advent of the character reading machines. At the present time these machines can read only certain type faces designed specifically for them. However, companies which anticipate the need for such readers in years to come would be wise to plan replacement of worn-out typewriters and accounting machines with new ones which are equipped with special wide-spaced, machine-oriented type fonts and high-quality inking. Then conversion in the future may be done without the huge expense of completely replacing data input equipment.

Points of Interest

C-E-I-R, Inc. has opened a computing center in London, England.

Delta Air Lines has linked 66 cities with its IBM SABRE airline reservation system.

The American Documentation Institute has organized a Southern California chapter.

The Sutherland Co. of Peoria, Ill., has published a brochure explaining the need for logic tables in management decision making. Write the company at Suite 1112, First National Bank Building, for a copy. ((See also DPD, this issue, pages 1 and 2.))

The Computer Center, 1417 S. Georgia St. Los Angeles, is a school for training data processing programers.

RCA Laboratories have designed an ultraminiature transistor made by depositing thin films by evaporation on an insulating base. The component "may shrink the basic circuitry of a computer to the size of a book page."

The Bureau of Public Roads of the U.S. Dept. of Commerce has inaugurated the National Driver Service, using an IBM 1401. This system has on file the records of motor-vehicle operators whose driving privileges have been withdrawn for driving while intoxicated or for conviction of a violation involving a traffic fatality. The States that make use of the Register will be able to prevent, or at least reduce the possibility, of the inadvertent granting of driver privileges to these individuals. The program is a voluntary, cooperative State-Federal enterprise. So far, 45 states and territories have agreed to participate.

Rese Engineering, Inc. A and Courtland Streets, Philadelphia 20, Pa., has available a brochure on the Findafact 2910 Data Retrieval System, a high-speed transistorized system which transcribes standard punch card data to magnetic tape, maintains the file and retrieves information on request.

The Waterbury National Bank, Waterbury, Conn., has established a commercial data processing center to furnish EDP facilities to companies which cannot afford a complete installation for themselves.

Automatic Programming Information is a bulletin of abstracts, references and library information published by the Automatic Programming Information Centre, College of Technology, Brighton, England.

Minute Maid Company, of Orlando, Florida, has installed an NCR 304 for its own use, and also offers data processing services to other companies.

National Computer Analysts, Inc., consultants on EDP equipment, applications studies, and installation, has moved to Route 206 Center, Princeton, New Jersey.

Newborn deaths may be reduced by 12 to 14,000 annually through evaluation of medical data collected by electronic computer under a program sponsored by the American Medical Research Foundation and Univac.

National Data Processing Corporation of Dallas, Texas, has designed the Transit Encoder, which prints the bank transit number-routing symbol in MICR type on documents. The desk design is a result of "human engineering," to make operation more efficient.

Univac has announced the Unisaver, a computer input teller set for savings bank accounting which provides input to the Univac 490 Real-Time System. Also announced is the Univac Solid-State II with both magnetic core and drum memory.

The Service Bureau Corporation, a subsidiary of IBM provides Project Control Methods, a computer service that uses PERT and Critical Path Scheduling. A free one-day seminar on the preparation of networks and computer input is included in the service. For a technical bulletin describing the Project Control Method write to: The Service Bureau Corporation, 425 Park Avenue, New York 22, New York.

Added to the RCA 301 product line is a random access, large-capacity, high-speed disc file in four models, ranging from 22 million to 88 million characters. Two files can be connected to the system. Each disc file holds from one to 24 magnetic discs 39 inches in diameter, in a vertical position. Data is recorded on both sides in six zones per side, with six magnetic read-write heads for each disc face. Monthly lease rates start at $3000.

Training

PERT/PEP Training Courses, sponsored by Institute for Management Dynamics, Operations Research, Inc.

Schedule:	Eastern Center	Western Center
	Sept. 11-15	Sept. 25-29
Fee:	$290	
Information:	For Eastern Center courses, write to Operations Research, Inc., Silver Spring, Maryland For Western Center, write to Operations Research, Inc., 225 Santa Monica Blvd., Santa Monica, California	

PERT/PEP Cost Seminars, sponsored by Institute for Management Dynamics, Operations Research, Inc.

Pre-requisite:	Graduation from ORI's PERT/PEP Course, or minimum six months active personal participation in design or operation of PERT/PEP system	
Fee:	$130	
Schedule:	Eastern Center	Western Center
	Sept. 18, 19	Sept. 21, 22
Information:	Write to same as above courses.	

Systems and Procedures Course, sponsored by American Management Association

Date:	Unit I:	Sept. 11-15, 1961
	Unit II:	Oct. 9-13, 1961
	Unit III:	Nov. 27-Dec. 1, 1961
Place:	AMA Academy, Saranac Lake, New York	
Fee:	$775 (AMA members: $675)	
Information:	Hollis Wyman, Course Director, AMA Academy, Saranac Lake New York	

Operations Research Development Program

Date:	September 18, 1961 - January 26, 1962
Place:	Case Institute of Technology
Fee:	$1000
For whom:	Intensive program at the graduate level for qualified scientists and engineers with industrial experience. Successful completion of the program is recognized by the award of a Certificate in Operations Research.
Information:	Professor Russell L. Ackoff, Case Institute of Technology, University Circle, Cleveland 6, Ohio

Information Storage and Retrieval Short Course, sponsored by University Extension, UCLA

Date: September 25 - October 6, 1961
Place: University of California at Los Angeles
Pre-requisites: Bachelor's degree with evidence of established interest in this field (2 units of professional credit are given)
For whom: Special libraries, equipment manufacturers, researchers, data processing personnel, military
Fee: $175
Information: H. L. Tallman, Physical Sciences Extension, Room 6501, Engineering Building II, University of California, Los Angeles 24, California

Computer Management Seminar, One-day seminars, sponsored by Philco Corporation

Date: October 10th, 1961; October 24, 1961; November 2, 1961 November 21, 1961; December 5, 1961; December 19, 1961
Place: Philco Computer Center, Willow Grove, Pa.
Information: C. A. Leventhal, Manager, Computer Education, Philco Computer Division, 3900 Welsh Rd., Willow Grove, Pa.

Electronic Data Processing for Business and Industry, Course #10, presented by Richard G. Canning

Date: October 23 through 27, 1961
Place: New York City (Hotel Warwick)
Fee: $250 (includes all class materials and lunch each day)
Information: Richard G. Canning, 614 S. Santa Fe Ave., Vista, California

1962 Engineering and Management Course, sponsored by UCLA Engineering Extension

Date: January 22 through February 1, 1962
Place: University of California at Los Angeles
Fee: $450 (includes all class materials, lunch each day and closing dinner)
Information: W. Clare Ennis, Assoc. Coordinator, The Engineering and Management Course, College of Engineering, Room 6266, University of California, Los Angeles 24, California

Meetings

Association for Computing Machinery National Conference

Date: September 5-8, 1961
Place: Los Angeles, California (Statler-Hilton Hotel)
Information: A. C. M. 1961 National Conference, Ben Handy, Litton Systems, 5500 Canoga Ave., Woodland Hills, California

NABAC National Convention (The Association for Bank Audit, Control, and Operation)

Date: September 11-13, 1961
Place: Chicago, Illinois
Information: NABAC, 38 South Dearborn Street, Chicago 3, Illinois

Third Annual EDP Conference of Electronics Committee of Retail Research Institute

Date: September 25 through 29, 1961
Place: Chicago, Illinois (Edgewater Beach Hotel)
Information: Miss Ethel Langtry, Research Director, Retail Research Institute, 100 West 31st St., New York 1, New York

International Systems Meeting

Date: October 8-11, 1961
Place: Cleveland, Ohio (Hotel Statler and Hotel Pick-Carter)
Program: "Systems Management in Transition"
Information: Systems and Procedures Association, 817 Penobscot Building, Detroit 26, Michigan

NMAA Division 5 Annual Conference

Date: October 12, 13, 1961
Place: Indianapolis, Indiana (Marott Hotel)
Information: NMAA Conference, P. O. Box 256, Indianapolis 4, Indiana

Univac Users Association Fall Conference

Date: October 12, 13, 1961
Place: Philadelphia, Pa. (Warwick Hotel)
Information: Walter Edmiston, Secretary, Univac Users Association, Philadelphia Naval Shipyard, Philadelphia 12, Pennsylvania

USE Meeting

Date: October 10-13, 1961
Place: Philadelphia, Pa. (Warwick Hotel)
Information: J. W. Nickitas, Secretary, USE, Remington Rand Univac, 315 Park Avenue South, New York 10, New York

"Application of Digital Computers to Automated Instruction," sponsored by System Development Corp. and Office of Naval Research

Date: October 11-13, 1961
Place: Washington, D.C. (Dept. of Interior Auditorium)
Information: Washington Liaison Office, System Development Corp., 1725 Eye Street, N. W., Washington 6, D.C.

Computer Applications Symposium, sponsored by Armour Research Foundation

Date: October 24, 25, 1961
Place: Chicago, Illinois (Terrace Casino, Morrison Hotel)
Information: Robert B. Brausch, Armour Research Foundation, 10 West 35th Street, Chicago 16, Illinois

NMAA Electronic Business Systems Conference, sponsored by NMAA Western Div.

Date: October 25-27, 1961
Place: Long Beach, California
Information: NMAA Western Division, P. O. Box 7365, Long Beach, California

Institute on Electronics in Management, sponsored by The American University

Date: October 30--November 3, 1961
Place: The American University, Washington, D. C.
Information: Prof. Lowell H. Hattery, Director, Center for Technology and Administration, The American University, 1901 F Street, N. W., Washington 6, D. C.

GUIDE International (IBM large-scale computer users)

Date: November 8-10, 1961
Place: Cincinnati, Ohio (Netherland Hilton Hotel)
Information: E. F. Cooley, The Prudential Insurance Co. of America, Newark, New Jersey

TIMS-ORSA 2nd National Meeting

Date: November 8-11, 1961
Place: San Francisco, California (Jack Tar Hotel)
Information: The Institute of Management Sciences, Box 273, Pleasantville, N. Y.

ACM Technical Symposium sponsored by Los Angeles, Orange County, and San Fernando Valley Chapters of ACM

Date: November 21, 1961
Place: Santa Monica, California (Miramar Hotel)

1961 Eastern Joint Computer Conference

Date: December 12-14, 1961
Place: Washington, D. C. (Sheraton-Park Hotel)
Theme: Computers--Key to Total Systems Control

References

DATA PROCESSING DIGEST does not provide copies of the original material digested or reviewed in this issue. The publishers' addresses are listed below for your convenience in writing to them for more complete information.

American City
470 Fourth Avenue
New York 16, New York

Armed Forces Management
1001 Vermont Ave. N. W.
Washington 5, D. C.

Auditgram
38 S. Dearborn St.
Chicago 3, Ill.

Automatic Data Processing
Mercury House
109-110 Waterloo Rd.
London SE 1, England

Best's Life News
75 Fulton St.
New York 38, New York

Business Automation
600 W. Jackson Blvd.
Chicago 6, Ill.

Challenge
Institute of Economic Affairs
New York University
475 Fifth Avenue
New York 17, New York

Communications of A. C. M.
1 E. 69th St.
New York 21, New York

Computers and Automation
815 Washington St.
Newtonville 60, Mass.

Data Processing
Gille Associates
22nd Fl. Book Tower
Detroit 26, Mich.

Datamation
10373 W. Pico Blvd.
Los Angeles 64, Calif.

Dun's Review & Modern Industry
99 Church St.
New York 8, New York

Journal of Accountancy
270 Madison Ave.
New York 16, New York

Journal of Machine Accounting
1750 West Central Rd.
Mt. Prospect, Ill.

Modern Railroads
201 North Wells St.
Chicago 6, Ill.

N. A. A. Bulletin
505 Park Ave.
New York 22, N. Y.

Purchasing
205 E. 42nd St.
New York 17, New York

Systems Management
10 E. 40th St.
New York 16, New York

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Managing Editor: Margaret Milligan

adams associates

COMPUTER CHARACTERISTICS QUARTERLY

June, 1961

Catalogued here are the salient features of sixty-one general-purpose, stored-program electronic digital computers, all of which have been or are being actively promoted for sale or rent in the United States.

The list is believed to be complete except for the omission of computers not manufactured in the U. S. A., computers intended almost exclusively as components in process-control or military systems, and some of the earliest computers about which little is now heard (e.g. IBM 701, IBM 702, Elecom 120).

To bring computers of comparable size into proximity with one another, they have been listed in order by decreasing cost even though a "typical monthly rental" figure is often difficult to establish and impossible to defend.

This chart is brought up to date quarterly and is also available printed on one side of a set of six 8½" x 11" sheets. The prices for the booklets and the sheet-sets are the same: $1.50 per issue; $5.00 per subscription of four issues.

	GENERAL CHARACTERISTICS					INTERNAL SPEED		MAGNETIC TAPE			PERIPHERAL EQUIPMENT					SPECIAL FEATURES					
											Input		Output							
	Typical Monthly Rental Monthly Rental Range	↘ Solid-State Date First Delivery	Storage Capacity and Type	Word Size	Instruction Addresses	Add Time	Average Access Time	Thousands of Characters per Second	Buffering	Maximum Tape Units	Cards per Minute	Paper Tape Characters per Second	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Random Access File	Random Inquiry
1 **IBM 7030 STRETCH**	$300,000 (200-)	✓ 5/61	16-262K core	64b	1[1]	2μ[1]	1μ[1]	62	MRWC	256	1000[2]		250[2]		600[2]	16	✓	✓	I/O	✓	✓
	The computer features an interrupt system, an input-output exchange (which relieves the computer of all input-output control) with a variety of peripheral equipment available. Effective speed will sometimes be faster than shown because of use of look-ahead and look-behind features permitting simultaneous access to several core storage units.																			
2 **UNIVAC LARC**	$135,000 (135-)	✓ 5/60	10-97K core	12d	1	4μ[1]	4μ	25	MRWC	40	1	1	1	1	1	99	✓	✓	I/O	✓	✓
	System includes a versatile processor unit which controls all input-output operations. A second computer unit can be added. The fast add time shown is obtained by means of an instruction look-ahead feature. Many types of peripheral equipment are available, including a high-speed film printer.																			
3 **IBM 7090**	$64,000 (50-69)	✓ 11/59	32K core	36b	1	4.4μ	2.2μ	15-62	MRWC	80	250[2]		100[2]		150[2]	3	✓	✓	I/O		
	A computer which features multiple read-write-compute by use of a 7606 Multiplexor and up to eight 7607 Data Channels. Each Data Channel acts as a separate input-output unit and as many as ten tape units can be attached. The computer may have equipment for direct transmission of data between it and an external data device.																			
4 **PHILCO 2000 Model 212**	$58,500 (47-79)	✓ /62	16-32K core	48b	1	.75μ	2μ	90	MRWC	256	2000[4]	1000[4]	100[4] 250[4]	60[4]	900[4]	8		✓	I/O	✓	✓
	An advanced (See entry #14) asynchronous system which provides processing of four instructions concurrently through instruction, indexing, arithmetic and store units. Up to nine input-output devices can be buffered to central processor. The Philco 2400 (entry #38) is available as an on or off-line input-output system.																			
5 **IBM 7080**	$55,000 (40-73)	✓ 8/61	80-160K core 1K core	1a	1	11μ[1]	2μ 1μ	15-62	MRWC	40	250[2]		100[2]		150 500[2]	0	✓			O	✓
	A variable-word length computer which has a program interrupt feature. Provision has been made for many combinations of on-line input-output devices, including a 1,000 lpm printer. Add time assumes a five-character field. Simultaneous transmit feature allows internal movement of data in parallel with other computer operations.																			
6 **RW 400**	$50,000[1] (10-)	✓ 3/61	9K core[1]	26b	2	14μ[1]	10μ	62	MRWC	24[1]	2000	300	✓	✓	900	✓			I/O	✓	✓
	A modular data system which employs concurrent processing. Speeds, capacities and costs above refer to a representative system. The system can be small or greatly expanded by adding modules, those available being computers, data buffers, tapes, drums, card readers, printers, display buffers, and peripheral buffers. Data buffers act as independent modules for tape control and search. A complete set of on-line displays is also available, and a comprehensive interrupt and inter-module communication system is included.																			
7 **UNIVAC 1107**	$50,000 (40-60)	✓ /62	65K core 128 film	36b	1[1]	4μ	4μ[1] .6μ	25 120	MRWC	192	600 700	400	150 300	110 300	600 700	15	✓	✓	I/O	✓	✓
	A computer featuring program-interrupt, thin film memory, overlapped core memory banks, half-word and multiple six bit operations. Basic single address instruction code allows machine to be used as a two or three address system for increased speed. Two types of flying-head magnetic drum units are available for auxiliary storage (average access times are 17ms and 8.5 ms).																			
8 **UNIVAC 1105**	$43,000 (40-55)	9/58	8-12K core 16-32K drum	36b	2	44μ	8μ 17m	21	RWC	24	120 300[2]	200	120[2]	60	600[2]	0		✓		O	
	A completely buffered version of the UNIVAC 1103A with increased storage facilities and faster tape drives. A visual display can be attached for on-line output. A program-interrupt feature enables processing of data from on-line units on a priority basis.																			
9 **IBM 709**	$40,000 (28-)	8/58	4-32K core	36b	1	24μ	12μ	15	MRWC	48	250[4]		100[4]		150[4]	3	✓	✓		O	
	The computer can have an auxiliary storage drum of 2,000 to 8,000 words. A maximum of three 766 Data Synchronizers may be attached to a system, each of which has two data channels. Each channel may have up to eight tape units attached. A cathode-ray tube display is also available for output. (See footnote [2])																			
10 **UNIVAC 1103A**	$35,000 (25-45)	3/56	4-12K core 16-32K drum	36b	2	44μ	8μ 17m	13	RC, WC[1]	10	120 300[3]	200	120[4]	60	600[3]	0		✓		O	
	The computer utilizes magnetic tapes with forward and reverse read and an interlace arrangement (addresses on drum spaced according to word times) to reduce drum access time. Tape buffering limited to one word. A program interrupt feature permits a switch to another program in microsecond time.																			

	Typical Monthly Rental Monthly Rental Range	✓ Solid-State Date First Delivery	Storage Capacity and Type	Word Size	Instruction Addresses	Add Time	Average Access Time	Thousands of Characters per Second	Buffering	Maximum Tape Units	Cards per Minute	Paper Tape Characters per Second	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Random Access File	Random Inquiry
11 **CONTROL DATA 1604**	$34,000 (19-35)	✓ 1/60	8-32K core	48b	1	4.8μ	6.4μ[1]	30	MRWC	96	250 1300	350	100	60 110	150 1000	6	✓	✓	I/O	✓	✓
A computer with two instructions per 48-bit word, overlapped core memory banks for increased speed, real-time clock, and program interrupt feature. It is compatible with IBM tape units. MRWC is achieved through the use of a multiplex-type device to scan three input and three output buffers.																					
12 **RCA 601**	$32,000 (24-68)	✓ 9/61	8-32K core	56b	2[1]	6μ	.9- 1.5μ	33-120	MRWC	63	600[4]	1000[4]	100[4] 200[4]	100[4] 300[4]	1000[4]	8[1]	✓	✓	I/O		✓
The computer uses variable-length instructions on either a character, word, or half-word basis; operations within the computer are in parallel within these categories. Overlapped core memory banks and the processing of different programs simultaneously are features. Eight index registers are available for each program. Double precision arithmetic is available.																					
13 **IBM 704**	$32,000 (24-)	4/56	4-32K core	36b	1	24μ	12μ	15	RC, WC[1]	10	250[4]		100[4]		150[4] 500[3]	3		✓		O	
The computer can have an auxiliary storage drum of 2,000 to 8,000 words and the use of a 774 Tape Data Selector is available to facilitate off-line printing selection. A cathode-ray tube display is also available for output. Tape buffering limited to one word. (See footnote [2]).																					
14 **PHILCO 2000 Model 210, 211**	$30,000 (27-66)	✓ 11/58	4-32K core	48b	1	15μ[1] 3.6μ[1]	10μ[1] 2μ[1]	90	MRWC	256	2000[4]	1000[4]	100[4] 250[4]	60[4]	900[4]	32		✓	I/O	✓	✓
A parallel, asynchronous system with a wide variety of instructions stored two per word, overlapped core memory banks, special instructions and repeat mode provide increased internal speed. Up to 32 auxiliary storage drums (32,768 words each) and program-interrupt are available. The Philco 2400 (entry #38) is available as an on or off-line input-output system.																					
15 **IBM 705 III I&II**	$30,000 (18-54)	3/56	20-80K core	1a	1	86μ[1] 119μ[1]	9μ 17μ	15-62	RWC	60 100	250[4]		100[4]		150[4] 500[3]	0	✓			O	
A variable-word length computer which can be used as a fixed (five-digit) word computer. Magnetic tapes are controlled in Models I and II by either a 754 Tape Control, a 777 Tape Record Coordinator, or a 760 Control and Storage unit. In Model III, a 767 Data Synchronizer is used. The use of more than one 767 allows MRWC. Add time assumes a five-character field. (See footnote [2])																					
16 **IBM 7074**	$29,300 (17-36)	✓ /62	5-30K core	10d	1	10μ[1]	4μ	15-62	RWC[1]	40	500[2]		250[2]		150[2]	99	✓	✓	I/O	✓	✓
A modified version of the IBM 7070 (See entry #20) which features the use of a faster core memory and a parallel adder circuit for increased internal speed. Magnetic tapes can be used in the binary mode. MRWC is possible when four channels are used.																					
17 **UNIVAC II**	$28,000 (25-30)	11/57	2K core	12a	1	200μ	40μ	25	RWC	16	240[3] 300[3]		120[3]		600[3]	0			I/O		
Features two instructions per word and magnetic tapes with forward and reverse read. Off-line equipment includes the Unityper II for direct recording of data on magnetic tape, and a paper-tape to magnetic-tape converter which can also be used to produce paper tape from magnetic tape.																					
18 **UNIVAC I**	$25,000 (20-30)	3/51	1K delay	12a	1	242μ	282μ	13	RWC	10	240[3] 300[3]	200[3]	120[3]	50[3]	600[3]	0			I/O		
Mercury delay lines are used for internal storage in this first commercially available computer. Duplicate circuitry is used to check all transfer of information.																					
19 **UNIVAC 490**	$25,000 (18-)	✓ 12/61	16-32K core	30b	1	4.8- 12μ	6μ	25 125	MRWC	192	600	350 1500	150	110	600	7			I/O	✓	✓
This parallel operation computer features execution of externally specified addresses, externally specified indices, and half-word logical operations. A variety of remote input devices for data collection is available to allow for real-time processing. Numeric information can be read at a rate of 175,000 characters per second.																					
20 **IBM 7070**	$24,000 (12-31)	✓ 6/60	5-30K core	10d	1	60μ[1]	6μ	15-62	RWC[1]	40	500[2]		250[2]		150[2]	99	✓[1]	✓	I/O	✓	✓
A computer which features priority processing (making it possible to interrupt one program, switch over to a second program, execute the instructions in the latter, and then return to the first at the point of departure). Add time is variable by the number of digits in the field to be added. Indirect addressing is limited to scatter and gather operations. MRWC is possible when four channels are used.																					
21 **UNIVAC III**	$22,500 (15-30)	✓ 6/62	8-32K core	6d	1	8μ	4μ	25 133[1]	MRWC	38	700	1000	300	110	700	15	✓	✓	I/O	✓	✓
A computer featuring a flexible storage word which may have four alphabetic, six decimal, or 24 binary characters plus sign. An instruction may process up to four data words. Numeric information can be read at a rate of 200,000 digits per second. Program interrupt and scatter and gather operations are other features. Up to eight additional input-output units can be connected for on-line operation.																					
22 **HONEYWELL H-800**	$22,000 (12-30)	✓ 12/60	4-32K core	12d	3	24μ	6μ	64[1]	MRWC	64	240[4] 650[4]	200[4] 1000[4]	100[4] 250[4]	60	150 900[4]	64	✓	✓	I/O		✓
A computer with facility for running up to eight independent programs concurrently. It uses an automatic error correction feature, called Orthotronic count, when reading magnetic tapes in either direction. The computer can be used as a binary machine with a word size of 48 bits. Numeric information can be read at a rate of 96,000 digits per second.																					
23 **BENDIX G-20**	$20,000 (7.3-35)	✓ 4/61	4-32K core	32b	1	15μ	6μ	120[1]	MRWC	500	650[4]	500[4]	250[4]	100[4]	1000[4]	63	✓	✓	I/O	✓	✓
All input-output units may operate either on- or off-line under program control. Input-output supervision can be delegated to control buffers. Variable instruction length permits multiple indexing. Numeric information can be read at a rate of 240,000 digits per second. All arithmetic operations are performed in the floating-point mode.																					

	Typical Monthly Rental Monthly Rental Range	✓ Solid-State Date First Delivery	Storage Capacity and Type	Word Size	Instruction Addresses	Add Time	Average Access Time	Thousands of Characters per Second	Buffering	Maximum Tape Units	Cards per Minute	Paper Tape Characters per Second	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Random Access File	Random Inquiry
24 **BURROUGHS 220**	$17,000 (8-45)	✓ 12/58	2-10K core	10d	1	200μ	10μ	25	none	10	300	1000	100	60	150 1500[4]	1		✓	I/O	✓	✓
	A computer featuring a magnetic tape system which can search and scan independently of the central computer. Five hundred million digits of random access memory are available.																				
25 **BURROUGHS B 5000**	$16,200 (13.5-50)	✓ /62	4-32K core 32K drum	48b	1-4	3μ	6μ 8.5m	24 66	MRWC	16	200 800		100		650	[1]	✓	✓	I/O		
	The user-oriented logical design features a Stack (working area), a Program Reference Table to handle data references, and four modes of central processor operation: Arithmetic (normal), Subroutine, Data Manipulation, and Control (in which an executive-type program permanently stored on a drum initiates input-output operations, determines multi-processing assignments and processes interrupt conditions). The functions of index registers are served by special means.																				
26 **RCA 501**	$16,000 (11-26)	✓ 11/59	16-262K core	1a	2	360μ[1]	15μ	33-66	RC, WC or RW	63	600[4]	1000	200[4]	100 300	600[4] 900[3]	8	✓[1]		O		
	A variable-word length computer featuring four-character (tetrad) parallel transfer, and magnetic tapes with forward and reverse read and dual recording. Indirect addressing is limited to scatter and gather operations. Add time assumes a five-character field, and uses duplicate adder circuits to permit checking of arithmetic operations.																				
27 **IBM 7072**	$15,800 (14-32)	✓ /62	5-30K core	10d	1	12μ	4μ	7.2-20	RWC	20	60[2]		[2]		[2]	99		✓	I/O		
	A low-speed, magnetic tape only, input-output version of the IBM 7070 (See entry #20) which uses a 1401E system for off-line input-output data conversion.																				
28 **NCR 304**	$15,000 (12.5-19)	✓ 11/59	2-4K core	10a	3	600μ 120μ[3]	60μ	30	RW[1]	64	2000[4]	1800[4]	100[4] 250[3]	60[4]	680[4] 900[4]	10		✓	I/O		✓
	A computer which uses two words per instruction. The internal commands include sort, merge, pack, unpack and a repertoire of microflow, single-address instructions. Pack and unpack can be used to condense numeric data in connection with the magnetic tape system which uses tapes without a space between records. In processing inactive records, RWC is achieved.																				
29 **UNIVAC File Computer I Model II**	$15,000 (8-21)	1/58 1/62	20 core 1K drum 2K core	12a	3	8.6m 3.4m	.9m 3.1m .63m	10.4	MRWC	10	150[4] 240[3]	200[4]	150[4] 120[3]	60[4]	600[4]	0			I/O	✓	✓
	A computer which can have up to ten general storage drums of 180,000 characters each (average access time is 17.6m). A search command for locating records on the drum is incorporated. An off-line sort-collate unit is available. In model II, core memory replaces the program drum.																				
30 **GENERAL ELECTRIC 210**	$14,000 (10.5-36)	✓ 11/60	4-8K core	6d	1	64μ	32μ	30 50	RWC	13	400 1500	200 500	100	60	1000[4]	1			I/O		
	A computer which features on-line and off-line handling of magnetically encoded documents through 1200-document-per minute sorter-readers (of which a two-pocket or a twelve-pocket unit is available). The printer can print magnetically encoded characters. The computer can be used in a double precision (twelve-digit) mode.																				
31 **CONTROL DATA 924**	$10,000 (8.7-20)	✓ 8/61	8-32K core	24b	1	9.3μ	6.4μ[1]	15 30	MRWC	96	100 1300	350	100	110	150 1000	6	✓		I/O	✓	✓
	A computer with overlapped core memory banks, real-time clock and program-interrupt features. It is a slower and shorter word length version of the 1604 (See Entry #11). No rental prices have been announced. Prices shown were derived from purchase price.																				
32 **IBM 650**	$9,000 (3.7-16)	11/54	1-4K drum 60 core	10d	1[1]	.7m	2.4m .1m	15	RC, WC	6	155- 250	60	100- 250		150[4]	3	✓			✓	✓
	The last part of the instruction word indicates the address of the next instruction. Tape records can be written in either BCD mode (six-bit characters) or straight numeric form (four-bit characters). It is possible to use the 774 Tape Data Selector as an off-line tape editor. The Ramac units can store up to twelve million characters per unit, of which there can be a maximum of four units.																				
33 **HONEYWELL H-400**	$8,700 (8.7-12)	✓ 9/61	1-4K core	12d	3	120μ	10μ	64[1]	RW	8	650	1000	100 250	60	900	3			I/O		
	A computer having some of the same features as the H-800. It offers Orthotronic count, magnetic tapes, and the same word flexibility, i.e., eight alphabetic characters, twelve decimal characters, and 48 binary bits. Numeric information can be read at a rate of 96,000 digits per second.																				
34 **NCR 315**	$8,500 (3.8-30)	✓ 1/62	2-40K core	2a	1[1]	36μ	6μ	24-60 100	none	8 16	400 2000	1000	100- 250	110	680 900	32			I/O	✓	✓
	A modular computer system with expandable internal memory capacity which can be used in decimal (3d word size) or alphanumeric format. The demand interrupt feature permits simultaneous operation of a number of peripheral units. Up to four magnetic character sorter-readers may be used for input while up to four printers and card punches may be used for output. Add time assumes a three-character field. Magnetically encoded cards on a drum (CRAM) permit random and sequential file processing.																				
35 **BURROUGHS 205**	$8,000 (2-17)	1/54	4K drum 80 fast	10d	1	1.7m	8.5m .85m	6	none	10	300	540	100	60	150	1		✓	I/O	✓	✓
	A computer system with fully buffered and edited card input-output and line printer. Independent search, through addressable blocks, on magnetic tape for up to one million 200-character records, and a full paper-tape system are features of this equipment.																				
36 **IBM 1410**	$8.000 (6-32)	✓ 12/61	10-40K core	1a	2[1]	110μ[1]	4.5μ	7.2-62	RWC	20	800	500	250		600	15	✓		I/O	✓	✓
	A variable-length instruction logic features a table-search command and 64 data-movement commands. The tape drives can be a combination of 7330 (7,200 characters per second), 729 II (15,000 or 41,662 characters per second), or 729 IV (62,500 characters per second). Random access discs with a capacity of up to 100 million characters and an average access of 500m are available. Add time assumes a five character field. Optical and magnetic-ink character readers are available.																				

	Typical Monthly Rental Monthly Rental Range	✓ Solid-State Date First Delivery	Storage Capacity and Type	Word Size	Instruction Addresses	Add Time	Average Access Time	Thousands of Characters per Second	Buffering	Maximum Tape Units	Cards per Minute	Paper Tape Characters per Second	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Random Access File	Random Inquiry
37																					
UNIVAC SS 80/90	$8,000 (3.5-13)	✓ 1/60	2.4-7.6K drum .2-1.6K fast	10d	1[1]	85μ	1.7m .425m	25	RC, WC	10	450 600		150		600[4]	3		✓		✓	
The last part of the instruction word indicates the address of the next instruction. In addition to working with binary coded decimal, some operations can be performed in binary. Random access drums (Randex) at 12 to 24 million characters are available. STEP card and tape systems allow increments of 400 words drum and 200 words fast memory to be added.																					
38																					
PHILCO 2400 Model 410	$7,800	✓ /62	8-32K core	1a	1	114μ[1]	6μ	90	RC, WC or RW	48	2250	1000	100 250	100	900 1200[1]	3			I/O		
An asynchronous, variable-word length computer employing variable-length instructions, dual program control and magnetic tapes with forward and reverse read. Available as an on or off-line input-output control for all Philco 2000 systems. Numeric information only can be printed at 1200 lpm. Add time assumes a five-character field.																					
39																					
GENERAL ELECTRIC 225	$7,000 (4.5-26)	✓ 3/61	4-16K core	20b	1	36μ	18μ	15-62	MRWC	64	400 1000	100-1000	100 200	110	900	96	✓	✓	O	✓	✓
Double-precision operations are included as part of the instruction repertoire. Facilities for handling magnetically encoded documents are available through 1200-document-per-minute sorter-readers. The computer can be connected with a transmitter-receiver unit for communication purposes. Average access time to disc file is 160 ms.																					
40																					
IBM 1401	$6,500 (2.5-11)	✓ 9/60	1.4-16K core	1a	2[1]	230μ[1]	11.5μ[1]	7.2-62	none[1]	10	800	500	250		600 1285[1]	3			I/O	✓	✓
A variable-word length computer using variable-length instructions. With the 1403 Chain Printer, this system can serve as an off-line input-output device for the 7070, 7080, and 7090 systems. Add time assumes a five-character field. Magnetic tape start time may be shared with computing. For numeric printing only, the printer can be run at 1285 lpm.																					
41																					
RCA 301	$5,000 (3.6-10)	✓ 2/61	10-20K core	1a	2	189μ[1]	7μ	7.5-66	RC, WC or RW	14	600	1000	200	100	1000	1	✓			✓	✓
A variable-word length, character-addressable system featuring magnetic tapes with forward and reverse read. Random access is available through disc Record Files (up to five, each with a capacity of 4.6 million characters). A special model featuring faster speeds in arithmetic and data transfer operations plus floating point arithmetic is also available. Add time assumes a five-character field.																					
42																					
RPC 9000	$4,500 (2.5-10)	✓ 9/60	72 delay[1]	12a	1	.23m	.8m	52[1]	MRWC	120	400	60 500	30 300		150 1000	0			I/O	✓	✓
A computer featuring external data memory on endless loops of magnetic tape, each tape loop storing up to one million characters. Internal memory consists of nickel wire magnetostrictive delay lines and is easily expandable. Single character commands and addresses make possible storage of 6 instructions per word. The 52,000 characters per second is a calculated search rate.																					
43																					
BURROUGHS B251 (VRC)	$4,000 (4-)	✓	4.8K core	1a	3	777μ[1]	10μ				100					0					
In this Visible Record Computer, magnetically-encoded ledger cards can be read through the machine at 180 cpm, and magnetic ink-imprinted documents can be read into the core storage at up to 1,560 documents per minute. The add time for this variable-word length computer assumes two five-character fields.																					
44																					
CONTROL DATA 160A	$4,000 (2.2-9.5)	✓ 7/61	8-32K core	12b	1	12.8μ	6.4μ	15 30	RC, WC or RW	40	100 1300	350	100	110	150 1000	0	✓		I/O	✓	✓
An advanced version of the CDC 160 (See entry #57) which has the same characteristics plus the larger memory (in modules of 8K), buffered input-output and program-interrupt. Magnetic tapes are compatible with IBM tape units and adapters are available for connection with IBM punch card equipment.																					
45																					
DEC PDP-1	$3,600[5] (2.9-15)[1]	✓ 11/60	1-16K core	18b	1	10μ	5μ	15	MRWC	64	100 2000	400	100	60	600	0	✓		I/O		✓
A computer with flexible input-output capabilities for custom applications. Options include: cathode-ray tube display with light pen, priority-interrupt, analogue input, built-in multiply and divide instructions. No rental has been announced. Prices shown were derived from purchase price.																					
46																					
EL-TRONICS ALWAC III-E	$3,600[5] (1.6-4)	/55	4-8K drum	33b	1[1]	1m	4m	21	RC, WC	16	100	200	100	60	150	1			I/O		
Two, three, or four instructions may be contained within one word. Half and quarter word operations are permitted. Magnetic tape units can be searched simultaneously with computer operations.																					
47																					
IBM 305 RAMAC	$3,600[5] (2.8-6.5)	12/57	100 core 2000 drum[1]	1a	2	30m	10m	15	RC, WC	4	125	20 60	100 200	60	30-50[1] 150	0			I/O	✓	✓
The computer has a 200-instruction capacity drum and the ability to call in additional instructions from the disc file, which is available in modules of five to 40 million characters (average access time is 600m). Input editing, logical decisions and character analysis are usually made through the 305 Control Panel. Each output unit has a separate control panel for format control. The "Stick" printer prints one character at a time.																					
48																					
AUTONETICS RECOMP II	$2,500[5] (2.5-4.5)	✓ 11/58	4K disc 16 fast	40b	1	1.08m	9m .95m	1.8	RC, WC	8	60	400 600	20 150			0	✓		I/O		
A desk-sized computer with magnetic disc memory, control console with decimal readout, and logical echo checking of output. The commands are stored two per word and feature square root and absolute value instructions in both fixed and floating point operations.																					
49																					
COMPUTER CONTROL DDP	$2,500[5] (2.3-)	✓ 5/61	4-16K core	24b	1	8μ	5μ	15-62	RWC	16	400	1000	100	100	600	1			I/O		
Additional features include the interrupt mode, visual display of control and arithmetic registers, analog input-output connections and magnetic tapes compatible with IBM-727 or IBM 729 III. Rental price is derived from purchase price.																					

	Typical Monthly Rental Monthly Rental Range	Solid-State Date First Delivery	Storage Capacity and Type	Word Size	Instruction Addresses	Add Time	Average Access Time	Thousands of Characters per Second	Buffering	Maximum Tape Units	Cards per Minute	Paper Tape Characters per Second	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Random Access File	Random Inquiry
50 **NCR 310**	$2,450[5] (1.6-6.5)	✓ 4/61	4K core	12b	1	12.8μ	6.4μ	15 30	none	20		350 1000		110	900	0	✓		I/O		
A system designed primarily for the banking industry, and featuring a magnetic ink character reader which can read 750 MICR documents per minute. The controller (central computer) is a version of the CDC-160. (See entry #57)																					
51 **RW AN/UYK-1**	—— ——	✓ 8/61	8-32 K core	15b	1-3	12μ	6μ	15 30	none	4		300		110					I/O		
Featuring stored logic, the computer allows "lograms" to be built from multiple micro-commands or "logands" which provides ability to change the logic of the computer for different applications. No purchase or rental prices are available but it is estimated that monthly rental will be approximately $2,000.																					
52 **RPC 4000**	$1,900 (1.8-4.5)	✓ 11/60	8K drum 128 fast	32b	1[1]	1.0m	8.5m 5.0m					60 500		30 300		1			I/O		
The last half of the instruction word indicates the address of the next instruction. A desk-sized computer featuring a repeat execution command which allows groups of from one to 128 successive words to be operated on within memory by one command at high speed.																					
53 **NCR 390**	$1,850 (1.4-1.9)	✓ 5/61	200 core	12d	4	11.3m	1.2m				15	400	15	17	110	0			I/O		
The magnetic ledger card stores data (about 200 characters) in magnetic tape strips on the back of the form while necessary printed information is on the front of the form. A programmable printer allows for any columnar arrangement on multiple forms and reports.																					
54 **IBM 1620**	$1,600[5] (1.6-5)	✓ 10/59	20-100K core	1d	2	560μ[1]	20μ	15-42	none	6	250	150	125	15	600[5]	0	✓		I/O	✓	✓
A variable word-length computer where alphabetic characters are represented by two decimal digits. A 320 character position table is used for arithmetic operations instead of adder circuits. Add time assumes a five-character field.																					
55 **AUTONETICS RECOMP III**	$1,500 (1.4-3)	✓ 6/61	4K disc 16 fast	40b	1	1.08m	9.3m 1.75m				60	10 600		10 150		1	✓		I/O		
A desk-sized computer with magnetic disc memory, optional floating-point operations and connections for varied peripheral equipment. It is a less-expensive version of the RECOMP II (See entry #48).																					
56 **BENDIX G-15**	$1,500[5] (1.5-4)	8/55	2K drum 16 fast	29b	1[1]	1.08m	14.5m .54m	.43	RC, WC	4	100	400	100	60	100	0			I/O		
Last part of instruction word indicates address of next instruction. Magnetic tapes, cards, graph plotters, and a digital differential analyzer are available. Alphanumeric input-output is completely buffered. Special accessories permit on-line use with analog systems.																					
57 **CONTROL DATA 160**	$1,500[5] (1.5-3)	✓ 7/60	4K core	12b	1	12.8μ	6.4μ	15 30	none[1]	20	100 1300	350	100	60	150 1000	0	✓		I/O	✓	✓
A desk-sized computer featuring parallel mode of operation and versatile input-output capabilities for handling a complete line of peripheral equipment. The instruction code allows no address, direct address, indirect address, and relative address modes. Magnetic tape start time may be shared with computing.																					
58 **RPC LGP-30**	$1,300 (1.1-2)	9/56	4K drum	31b	1	2.26m[1]	8.5m					200		20		0			I/O		
A desk-sized computer featuring an interlaced pattern of word addresses on the drum, which reduces memory access time. An oscilloscope displays contents of control register, instruction register, and accumulator.																					
59 **PACKARD BELL PB 250**	$1,200[5] (1.2-6)	✓ 12/60	2.3-16K delay 16 fast	22b	1	24μ	1.5m .09m	2	none	6		10 300		10 110		1			I/O		
The commands include double-precision arithmetic, variable-length multiply, divide, and square root. Peripheral equipment includes card equipment and analog-to-digital and digital-to-analog converters. Internal storage is magnetostrictive delay lines.																					
60 **BURROUGHS E-101**	$1,000 (.9-1.4)	/56	220 drum	12d	1	50m	10m					20		10	60	2			I/O		
A desk-sized computer using pinboard programming. Multiple paper-tape input and output and card input and output are optional. Simplicity of programming and operator control are major characteristics of this equipment. Machine now being marketed as the E-103.																					
61 **MONROBOT XI**	$700 (.7-1)	✓ 5/60	1K drum	32b	1	9m	6m				15	20	15	20					I/O	✓	
Limited random access inquiry is available via the drum and one or two paper-tape loops. Input-output facilities, up to any combination of three units, are time-shared.																					

FOOTNOTES

[1] — See remarks immediately beneath the computer data in question.

[2] — The IBM 1401 system (entry #40 in the chart) is available for use as an off-line input-output device.

[3] — This peripheral equipment is available off-line only (i.e., it can be connected to a magnetic tape unit independently of the central computer).

[4] — This peripheral equipment is available with the same characteristics both on-line and off-line.

[5] — The cost of magnetic tape units has not been included.